Museum Exhibit Content Recommendation and Guidance System Focusing on Experience Design

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Abstract. With the growth of economic and the change of consumers' needs, the museum gradually adopts the concept of experiential marketing. The guidance system has played an important experience media. Its development process of services model starts from "one-way standardization" and "passive customization", to "active customization" and "personal adaptability", trying to attract visitors by providing unforgettable and unique experience. This study integrated different scholars' "experience" viewpoints and principles, utilizing design innovation to develop recommendation and guidance systems of content displaying, which consists three man-machine systems, four databases and three core techniques. Furthermore, this study established violin exhibition as an example to descript the "actively customized and recommended displaying content" innovative experience model of "artificial intelligence people" and "invisible encircling".

Keywords: Index Terms—interactive design, guidance system, experiential design, experiential economics.

1 Introduction

Collection, research, exhibition and education are the four main functions for a museum. Gradual diversification of museum types not only reflects the progress of society but also evolutes because of higher demand expectations.

With no doubts, visitors are core for the museum to bring its functions into full play, and exhibit and guidance system is certainly the key factor. In 1907, The US Boston Museum brought in human narrator for the first time, while the mechanical audio guidance system did not appear until 1959 (Lin, 2004). The guiding type of "Man-to-Man" has flexibility to adjust contents and interacting way according to each visitor. "Personnel guidance" approach can be divided into three major categories, which are teaching style, inquiring style, and leading style (Alison L. Grinder & E. Sue McCoy, 1985). Many people believe that personnel guidance can fulfill the function most; however, it also requires the highest labor cost. Now the museum begins to utilize technological media as the guidance tool (Lin, 2004). The development of guidance system evolved from initially "man-to-man" (that is, narrator-to-visitor) to

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"device-to-man". In early period, "audio guidance" mode was extensively adopted. Visitors were required to carry hand-held devices with headphones, and all the hand-held devices provided the same information, which focused on standardized one-way service. In recent years, because of vigorous development of multimedia guidance system and a substantial increase in labor costs, "man-to-man" guidance approach has gradually substituted by "device-to-man" mode. Visitors started to have two-way interaction with devices, and they could select information they need. That is, the devices provided "passive customized services". With the breakthrough of file compression format and wireless networking technology, digitalized exhibition information can be stored in remote server. The devices visitors actually hold or approached are getting smaller and smaller. Currently, every major computer companies devoted to develop gesture controlling technology, which made the characteristic of guidance system shift from "visible", "hold" to "invisible", "enclose". And referring to the development of content recommendation technology, it also changed from "passive" selection to "active" recommendation in accordance with each visitor's characteristics. The narrators started from the "natural person" have evolved into the "artificial intelligence" or "digital virtual human" as well, forming a new service type of "machine to be people".

In order to fulfill various people's demands, the service types and providing method of museums have become diversified. Besides facing competitions from the same profession, the rapid development of other leisure services industry also make museum must find ways to provide more diversified and adaptive services to attract visitors. Under the influence of experiential economy, the experiential marketing strategy introduced into design of museum exhibition will be an inevitable trend. This study conducts experiential design theory to innovate museum guidance mode, of which three core concepts are proposed as follows:

1. Customization: providing proactive customized virtual guides to arouse visitors' self-motivations to learn.
2. Adaptability: recommending personal adaptive guidance content, and strengthening the visitors' self-learning effects.
3. Interaction: creating a unique visit experience through interaction with the exhibition information.

According to the aforementioned design concept, this study takes "Augmented-reality Teller (ArT)" for museum guidance system as an example to descript the "proactively customized and recommended displaying content" innovative experience model of "artificial intelligence people" and "invisible encircling".

2 The Evolution and Current Status Analysis of Museum Guidance System

Nowadays, museum guiding types can be simply divided into "digitalized guidance" and "mobile guidance". Digitalized guidance is scenario-oriented learning model, presenting guidance service information on displaying entities with word, pictures, audio and other multimedia. Mobile guidance is provided by the auxiliary devices, such as personal digital secretary (PDA), Pocket PC (Pocket PC), headphones, label

sensors; it downloads information of displayed items through the wireless network, which are not subject to space and time limit for on-demand viewing display information. In 2009, Ron Wakkary et al. developed the hybrid guidance system between the two. This device consisted a tabletop display (touchable monitor table), which can be provided for many people, and multiple sets of personal mobile guidance devices. The guidance system considers small group as their services target (Group Museum Guide), for instance, family. They can use the tabletop display to inquire information of exhibitions, processing social interaction through mobile guidance devices, and getting involved in experiential learning. In comparison with personal guidance, group museum guidance can let the visitors in the same group communicate mutually and share what content they heard, or leading other group members by one of them.

Table 1. Context layer, construct the principle of interactive experience and the key factors influencing learning effect

Context	Principle of interactive experience	Key factors
Personal Context	(1) Each visitor may use different way to learn, according to past knowledge, experience, and believe, interpretation information gaining from the museum. (2) All the visitors use their personal views to interpret museum's information in order to match their own knowledge and experience. (3) Every museum visitor has their plan on the visiting journey and is full of expectation.	(1) Motivation and Expectations (2) Prior knowledge, interests, and beliefs (3) Choice and control
Socio-cultural Context	(4) Most visitors won't go museum alone, and they usually follow a certain social group. What they see, do, and remember is all influenced by other members in the group. (5) The visitors' experience in museum includes narrators, security guards, sellers, and other visitors.	(4)Within-group socio-cultural mediation (5) Facilitated mediation by others
Physical Context	(6) The reasons why visitors are attracted to museum are that they think there are some unusual things they cannot see in daily life, therefore visitors "see" respectively in the museum in their own way. (7) Visitors are impacted strongly by museum, including architecture, atmosphere, flavor, sound, and the "feeling" toward this place. (8) Visitors can only pick a little part in numerous experiences (9) Visitors' attentions are strongly influenced by where they are and the design of museum circulation.	(6) Advance organizers and orientation (7) Design (8)Reinforcing events and experiences outside the museum

"Robot Guidance" is another branch of extension development. In addition to providing multimedia visiting information, there are some advantages of “mobile guidance” to break the space constraints. The research focus in recent years emphasizes on making the robot life-like (humanoid) (D. Matsui et al., 2005). With the evolution of guidance types, a variety of technical methods have emerged, for examples, the so called RFID (Radio Frequency Identification), facial recognition system, and GUI (Graphical User Interface). Users can utilize the “Tangible user interface (TUI)" and “Embodied Interaction" which make entities and digital information interacting, and

"Augmented Reality (AR)" technology which integrates the virtual items into the scene of life, to let them observe displaying items with more intuitions, interact with exhibitions, and create both virtual and physical experiences.

Falk & Dierking (1992) modeled interactive experience (The Interactive Experience Model) as a framework, collated the relative museum visit researches, and analyzed three contexts of visitors (Personal Context, Socio-cultural Context, and Physical Context). This framework rendered the interaction between contexts as the abstraction concept to present museum experiences and it also proposed 9 principles of exhibition experience structure and 8 key factors influencing the effect of museum learning. (Table 1)

The museum visiting experience is an interactive result between "ideal experience" (hope and expectation) and "real experience" (the actual event). The definition of experience is "when a person attains a certain level of emotion, intellect, and even the spirit, the good feeling arises from his consciousness. The essence of experience is individual, it's impossible for any two people to have the same experience (Pine & Gilmore, 1999)". Pine & Gilmore (1999) divided experience into two orientations including the level of participation (active participation and passive participation) and contact (absorption and immersion), which then formed four quadrants, that is, four types of experience: education, entertainment, aesthetic, and escapism. The richest experience will include all the four types, and they pointed out the main procedure of creating experience: setting the theme, building stories, deep impressions, and influencing behavior.

After comparing visitors' experience types and the current state of guidance system, this study found out that experience should include all the visiting process, however, recent system usually focus on "during visit". As a result, the museum guidance system must extend from a single individual to a system and cover the service range to "pre-visit" and "post-visit". In addition to extend the scope of services, this study emphasizes on the depth of experience and learning in each stage as well. Therefore, this study investigates every developable innovative chance in each stage separately from the viewpoint of personal, socio-cultural, and physical contexts. (Figure 1.)

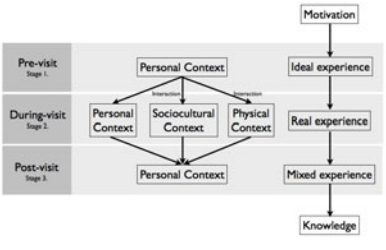

Fig. 1. Developable innovative point in each visiting stage

Referring to personal context, traditional guidance system cannot raise expectation before visitation. The past "ideal experience" construction model is based on a variety of propaganda profiles, websites, blogs, and other sharing channels. Museums did not arouse visiting motivation actively. It depends on whether visitors are interested in exhibition. The educational role museum plays should try to "turning extrinsic moti-

vation into intrinsic motivation (Chang, 1996)", and think how to make the image of "ideal experience" guidance as the key point through the design of guidance system.

In terms of personal and socio-cultural context, services provided by digitalized guidance and mobile guidance are "Man-to-machine" interactive platform, not "Man-to-Man". As a result, "Machine anthropomorphic" concept should be able to make up for this deficiency. As for personal and physical contexts, current guidance system provides "passive" customization than "active". The so called passive customization is that visitors must clarify what they want to see. However, they won't spend too much time to think what they want in a constrained time. The objective of active customization is that systems can previously have certain understanding toward visitors in accordance of visitors' backgrounds. When visitors enjoy in the situation and would like to explore for more knowledge, systems can actively provide adaptable displaying information or passively furnish any other information in accordance to visitors' needs for intensifying "real experience". Moreover, exhibits and guidance system are often considered as individual identities. Exhibition has its theme, so experience should also be themed. For the security reasons of exhibits preservation, exhibits are usually covered with transparent glass. Out of curiosity, many children like to touch glass with hands and forehead to make them closer. Taking this behavior into consideration, suppose transparent glasses are the interaction interface between visitors and exhibits, in addition to achieve the function of preserving, it also helps to activate these cold exhibits. Therefore, design of guidance system should break the barrier, and create a unique experience for the entire visiting process by a variety of sensory stimulations.

3 The Museum Displaying Content Recommendation and Guidance System

Starting from users' demands or wants, then basing on the three contexts of experience models, nine principles, and eight key factors to expand innovative planning provides the experiential content framework and program to establish museum displaying content recommendation and guidance system - Augmented-reality Teller (briefly as "ArT" hereinafter). This study takes museum as the field and sets violin as the target to develop detail design. In accordance with the needs of administer system management, it points out the system framework and technological integration method. The exhibition space could be simply divided into three parts, showroom, exhibition area, and exhibition unit. In this study, exhibition unit would be introduced as the main target to illustrate the significant innovative content of ArT system.

ArT system consists mainly of three human-machine systems, four databases and three core technologies (Figure 2). Among the three main systems, user side (User) consists of ticket-taking system, character-making system, and displaying windows. It's a platform directly contact with visitors. And management side (Server) mainly includes demographic data, lifestyle data, personal narrator database, exhibits database, and story database. These four databases are joined through three core technologies and three main systems, including face recognition, speech recognition and synthesis technology, as well as the content recommended techniques.

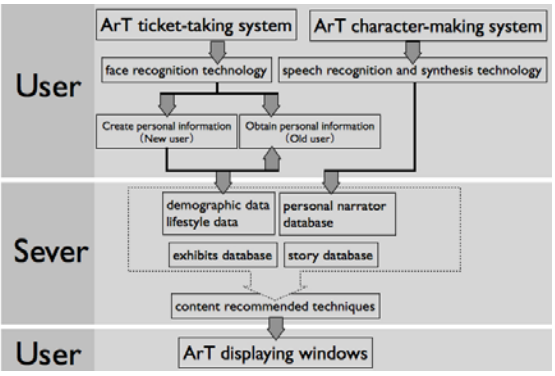

Fig. 2. Framework of ArT system

3.1 Ticket-Taking System

Visitors are allowed to enter the exhibition area by the RFID label tickets which can recognize their identity. In order to provide personal guidance, information, and adaptable services, visitors can operate ticket-taking devices to make system recognize them. This device has convenience, flexibility, and it is equipped with hidden physical IT apparatus. Besides, it's also introduced the concept of universal design to meet different groups' requirements (such as wheelchair users and children). The system utilizes face recognition technology and connects it to demographic database for comparison to see whether it is the initial visit or revisit. Suppose it's the revisit, system will access data comparison with visitors' current and previous appearance, so that it will adjust greetings statement to make visitors surprising and feel friendly. Otherwise, suppose it's the initial visit, visitors will be asked to fill out the demographic and lifestyle questionnaires to let system get familiar with them. The complete data could be obtained gradually through the interaction in visiting. When visitors are completing questionnaires, the system default virtual narrator will have interactive conversation with them, and system will recommend virtual narrators to accompany visitors for visiting as well.

After finishing questionnaires, visitors can choose exhibits which they are interested in. The ticket-taking system will automatically recommend other five exhibits to constitute a series of display units. Or, the system built-in recommendation platform will plan appropriate visiting schedules.

3.2 Character-making System

Visitors can select whether to adopt the recommended narrator or make other choice. Making visitors create their favorite narrators is believed to enhance their learning motivation. There are three main categories for visitors to choose, including "Top ten popular tellers in this week", "Favorite movie stars", "Building personal characters". The former two are voted by visitors and chosen by system as representative characters in accordance with the result of lifestyle questionnaires. And the third is to use the photo shoot taken in that day to create a virtual narrator which make the visitor

oneself as a protagonist. In addition, visitors can choose their favorite narrator's voice. System uses synthesis and recognition technology to remix, or it could convert the character database's text content into different voices.

3.3 Displaying Window System

With the appropriate displaying contents and entertainment interaction interface provided on the recommended technology platform, visitors can obtain the "interactive" services through this interface. There are sensor devices on the displaying windows, which can sense visitors around and start to guide served by the exclusive narrators they picked. This system makes use of augmented reality technology to display both physical exhibits and virtual information images on the user site in the same time. The transparent touchable panel in front of the exhibit in the displaying window can offer different auditory and visual feedbacks to have visitors interact with exhibits based on visitors' and exhibits' characteristics. It not only achieves the effect of edutainment but also enhance visitors' experience in innovative way. ArT system recommends based on visitors' lifestyle characteristics. In comparison with the traditional recommendation system of related principle, ArT system can effectively improve the insufficiency of databases, low effectiveness when new exhibit items are added, and offer users displaying content information that are more closer to their preference.

Taking violin as the example to interpret visiting experiential model: when the displaying window senses that there are visitors coming, the preselected and exclusive narrator then appear. This virtual narrator will introduce relative background stories to them and test visitors whether they absorb information or not at times, also, inquire for their opinions. Visitors can interact with virtual narrators through touch panels, and even more they can "remote touch" the violin. When touching certain violin's string, it will sound corresponding to that string. And when someone touch violin's waist, virtual narrators will humorously responded: "wrong touching, it's itching!" Also, visitors can enlarge the virtual violin on the touch panel to see the detail. Besides the themed information provided by virtual narrators, visitors are able to select the information they want. And the offerings of extended information are based on visitors' lifestyle background. After appreciating these exhibits, the displaying window interface will hint visitors the direction toward next exhibit, so that it will delight visitors and keep them watching the exhibition.

4 Test and Assessment

The ArT system proceeded to test after completing establishment. There were 10 testers with various design backgrounds (5 in industrial design, 2 in information management, 2 in engineering science and technology, 1 in visual design) invited to practically operate these three subsystems and give qualitative opinions for improvement. After improving the design, another 197 subjects were invited to test the displaying window recommendation system, comparing whether the lifestyle recommendation system are different from traditional one. The obtained analysis data abstract are listed below: The qualitative opinions are mainly the three:

1. The ticket-taking system: Some testers pointed that the items of lifestyle questionnaire are too much, so that the respondents may lose their patience. In the planning considerations, these questionnaire items can be separated in different exhibits to reduce the bad feeling which is aroused from too much items. Nevertheless, constraining to a single exhibit is hard to provide desired ideal experience.
2. The character-making system: Some testers mentioned that it really interested them to use. Almost all of them agreed on establishment of exclusive narrators.
3. The displaying window systems: Many testers indicated that the personal narrators indeed offered the exhibition information that is much more in line with their preference. However, this system can only serve one visitor at one time; other onlookers must wait in patience, so they may lose their interest. And some testers also indicated that the public way may interrupt other visitors, therefore they suggested that it could be considered to install headphones.

In terms of the performance of recommendation system, the effects and satisfaction between lifestyle recommendation and tradition recommendation by "Recommendation Performance Evaluation Index" and “The Museum Guidance Index” were compared. The former adopted “Maximum Average Error” to analyze gaps between recommendation system’s forecast and the degree of consumers’ adoptability. The smaller the gap is represents the more accurate recommendation systems predict. The latter adopted Bitgood's(1988) principle of evaluation of museum exhibition to measure whether this exhibition is good or not. The main indicators and methods are below:

1. Attraction: using recommendation rating score to analyze whether different recommendation method have difference on the degree of visitors’ adoptability. The higher the rating score, the more attractive this recommendation system is.
2. Sustainability: Analyzing the time a tester focuses on the exhibit can effectively evaluate whether the information provided by recommendation system interests visitors.
3. Simulating power: Using “actively learning motivation” satisfaction survey data to investigate whether different recommendation system have simulating power on visitors or not. Expecting that visitors will be more willing to actively know exhibits and dig for more knowledge.
4. Satisfaction: Investigating tester’s degree of adopting on recommendation by “recommendation satisfaction”.
5. Revisiting ratio: the degree that users are willing to use recommendation system again.

The investigating result showed that, in “Recommendation Performance Evaluation Index ", lifestyle recommendation is truly better than traditional one. “The Museum Guidance Indexes” of attraction, sustainability, and satisfaction are all superior to past recommendation system’s effect, but there are no significant differences in simulating power and revisiting ratio. Finally, based on preliminary test results, the visiting experience mode could be concluded (Figure 7). The design of the ArT System in accordance with three main concepts (customization, adaptability, and interaction) can

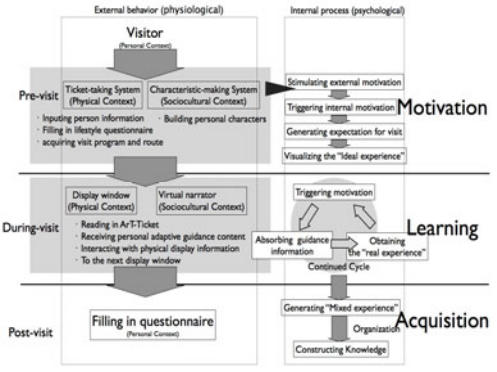

Fig. 7. The visiting experiential mode of ArT system

interpret the "Actively Customized Recommendation System" innovative experience mode of "artificial intelligence people" and "invisible encircling".

5 Conclusion and Suggestion

The future development trend is from "customization" to "community". In addition to offer personal services, there should be interactive mechanism during visiting. This study adopts the point of view of Humanity and Social Science, and also it is learning-oriented. Through the established and demonstration of "Virtual Guidance System", visitors are able to learn by themselves, self-explore, and put museum's educational objective into practice. That is, helping visitors convert "experience" into "knowledge".

"Recommendation Performance evaluation index" showed that, the effect of adoptability displaying content recommendation by lifestyle pattern is better than the pattern of traditional recommendation system. And "The museum guidance index" indicated that lifestyle recommendation system has a better performance in the dimensions of attraction, sustainability and satisfaction, but there are no significant differences in the dimensions of simulating power and revisiting ratio.

Despite the installed displaying window cannot serve many people at one time, it offers tranquil and quality aesthetic experience for individual visitor. Nevertheless, in terms of the trend guidance system develops, when it comes to the importance of sharing with others during the visiting tour, ArT system might be slightly weak in socio-cultural context. It could refer to hybrid system pattern to accommodate both individual and group visitors in near future.

The personal narrators can improve visitors' self-learning motivation. However, the "ideal experiences" arouse before visiting museums are influenced by exhibition propaganda, Internet-based media or other factors. Future research could make more effort on it.

Most of the testers are satisfied with the entire performance of system. How to expand system's services to post-visit so that completing the visiting experience, and how to be further supported by technology, organize experience effectively, then construct knowledge, is a field awaiting to be explored for the follow-up research.

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